THE AIRCRAFT CO_2 STANDARD

In 2016, the International Civil Aviation Organization (ICAO) adopted the world's first CO_2 Standard for new aircraft types. This Q&A document provides details on this standard, which comes into force from 2020.

Following six years of negotiations between governments, with industry and environmental group observers, the International Civil Aviation Organization (ICAO) has designed the world's first CO_2 efficiency standard for aircraft. New technology is one of the sector's pillars of climate action (as well as sustainable aviation fuels, improved operations, efficient infrastructure and a global market-based measure). The CO_2 Standard is a key step in formalising new technology efficiency measures.

The CO_2 Standard for aircraft:

- Reduces aircraft CO_2 emissions by encouraging the integration of fuel efficient technologies into aircraft design and development.
- Ensures that less-efficient older aircraft models end production in an appropriate timeframe or that manufacturers invest in technology to improve their efficiency. The standard also ensures that new designs go beyond the highest fuel efficiency of today's aircraft.
- Is a challenging and robust standard that brings CO_2 emissions into the formal certification process that new aircraft need to pass in order to enter service.
- Is a significant milestone for the sector: the first such standard for aircraft and is key to the sector's long-term commitment to reduce CO_2 emissions from aviation.
- Is part of a basket of measures to deal with industry's climate impact which include improved operations, sustainable alternative fuels, better use of infrastructure and new technology (which the CO_2 Standard will support).
- Is complementary to an agreement in 2016 on a global market-based measure to cap the growth in aviation CO_2 emissions and meet the industry's mid-term goal.
- Was developed by the ICAO Committee on Aviation Environmental Protection (CAEP) over a six-year period through 26 meetings and some 700 papers and pieces of analysis by 170 aviation experts from governments, industry and environmental groups.

Why develop the CO_2 Standard?

» It is the right thing to do — for the future of the sector, for our customers and partners and for the environment.

» Fuel efficiency is central to aviation's business and sustainable growth strategy — as evidenced by the huge gains in fuel efficiency over the decades.

» The formalisation of a CO_2 Standard for aircraft is an important part of the sector's overall basket of measures for climate action and is complementary to the significant work already underway in the sector: new aircraft and alternative fuels technology; optimising operational procedures; and improved infrastructure.

» The Standard will ensure that all newly-developed aircraft and engines incorporate the latest commercially-available proven technologies, mindful that no single technology can be applied across the entire range of new aircraft and engine models from small regional and business aircraft to the very large capacity long-range commercial aircraft.

» The industry has always prioritised efficiency improvements — in fact, aircraft and their operations have been consistently improving since we started flying jets — this formalises existing practices.

» Importantly, the CO_2 emissions of aircraft become part of the certification process, alongside safety compliance and noise measures, among other elements.

» The establishment of the first global CO_2 Standard will allow monitoring and progress in the future towards achieving CO_2 emissions reductions in line with research and development targets and technical feasibility.

Which aircraft will be covered by the CO_2 Standard?

» Jet aircraft which have a maximum take-off weight of over 5.7 tonnes (in other words, all commercial jet aircraft and all except the smallest business aviation jets).

» Higher stringency level for jet aircraft over 60 tonnes (which make up over 90% of commercial jet aircraft).

» Propeller aircraft which have a maximum certificated take-off weight of over 8.6 tonnes (which includes all but the smallest commercial propeller aircraft).

- These cover virtually all of the aircraft types in the global commercial fleet.
- Passenger, cargo and business aircraft are covered.
- Two categories are included, new aircraft types and aircraft that are 'in-production':
- All new aircraft types, for which manufacturers will apply for a 'type certification' after 1 January 2020, will be covered (with aircraft below 19 seats covered from 2023).
- All aircraft models that are currently being produced will have to meet the 'in-production' CO_2 Standard after 2023 if they undergo modifications that require re-certification.
- All remaining in-production aircraft will have to comply by 2028. This effectively means a production cut-off from 2028 for aircraft that do not meet the CO_2 Standard.
- Very small aircraft (weighing less than 5.7 tonnes) have not been included. They are often operated either privately or by very small airlines (such as single-aircraft operators flying between islands) and collectively emit a very small proportion of CO_2.
- Under sensible exceptional circumstances, certification authorities can grant exemptions from the obligation to be CO_2-certified to aircraft produced in very low volumes. Some special-purpose models such as firefighting aircraft are also exempted from CO_2 certification.

What were the different stringency levels under discussion?

- Stringency relates to the 'strength', or 'level' of the standard.
- The process of arriving at the standard was necessarily complex and included consideration of numerous options, thresholds, and other factors. In the end, the standard agreed meets the ICAO CAEP criteria of environmental effectiveness, economic reasonableness, technological feasibility and consideration of interdependencies.
- As part of negotiations and technical decision-making, a detailed economic analysis was completed which modelled the impacts of different stringency levels on CO_2 emissions, airline fleet evolution and cost of new technology.
- The ICAO decision by Governments reflects that these stringency levels provide the best balance of environmental benefit, technological feasibility; economic reasonableness and consideration of interdependencies.

How does the CO_2 Standard work?

- The metric is complex and not easily explained, as it has been developed to be equally applied to a range of aircraft types and treat them similarly.
- However, put very simply, it is based on the aircraft's performance during the 'cruise' phase of flight, expressed in kilograms of fuel per kilometre of flight, which is then adjusted to account for the fuselage size. Instantaneous fuel burn is determined under optimal cruise conditions and averaged over three measurement points at the beginning, in the middle and at the end of cruise flight.
- The CO_2 Standard focuses on cruise flight performance because the cruise portion of a flight is typically when the most fuel is consumed and the majority of CO_2 is emitted.
- It takes account of the 'transport capability' of the aircraft — i.e. how much can be transported and how far it is transported. These two elements, the payload and the range, are essential in the design of any aircraft.
- For each aircraft type, depending on its size and weight, the CO_2 Standard defines a maximum metric value (fuel burn per flight kilometre) that may not be exceeded.

Is the CO_2 Standard 'strong' enough?

- Yes. The agreed CO_2 Standard has achieved the best balance of environmental benefit, technological feasibility, economic reasonableness and consideration of interdependencies. It embodies an appropriate level of regulatory pressure whilst allowing the marketplace to determine the makeup of the global aircraft fleet.
- The more stringent the standard is, the longer it will take to get new technology to market in order to meet the standard — it will also probably be more costly. This in turn could lead to airlines flying older, less-efficient aircraft for longer, causing more CO_2 emissions. The final CO_2 Standard is therefore sufficiently stringent, without being restrictive in such a way that would have been counter-productive.
- The interdependencies of any given metric must be considered. For example, technical measures can be implemented which reduce CO_2 from aircraft but will increase noise and/or other emissions. When setting the CO_2 Standard, a determination had to be made on how best to balance those interests.
- A CO_2 Standard for aircraft was always going to be a complex exercise, more so given the international nature of the sector: aircraft are not only manufactured in Europe and North America, but also in Russia, China, Ukraine, Japan and Brazil.
- As part of the negotiations on any standard such as this, a balance must be reached between what is desirable for the maximum environmental benefit and what is ultimately practical and reasonable to implement.
- In the end, the stringency levels agreed at ICAO are both ambitious and realistic.

What will the Standard mean in CO_2 reduction?

» Even in the absence of regulations, the economics of aviation have dictated for decades that each new generation of aircraft is roughly 15-20% more efficient than the model it replaces. The CO_2 Standard mandates that these improvements continue.

» However, the continuous development of new aircraft and engine technology, underpinned by the CO_2 Standard, is only one part of overall aircraft efficiency improvements.

» The aviation industry approach focuses on several pillars of climate action: reducing fuel use (and CO_2 emissions) through new technology and alternative fuels; better operations of existing aircraft; and improvements in infrastructure.

» For all emissions that cannot be reduced through these pillars, a global market-based measure will be used to offset the remaining emissions in order to meet the targets set by the industry.

How does it differ from business as usual?

» "Business as usual" in aviation actually already means constant efficiency improvements — it can be seen in the fact that today's aircraft are well over 70% more efficient than the first jets: efficiency is part of the aviation sector's DNA.

» The CO_2 Standard formalises the improvements that have, until now, been purely market-driven.

Why does the CO_2 Standard only come into effect in 2020? Why not immediately?

» Once the standard is approved, it must be translated into local legislation by national civil aviation authorities. This takes time and therefore 2020 is a practical start date.

» Aircraft and their engines are incredibly complex machines and, with safety the number one priority for the industry, any modifications must be properly tested and certified before they enter commercial service. This takes time.

» A typical aircraft can take a decade to design, test and build due to the complexity, technology, advanced materials and rigorous testing and certification processes involved. They can stay in service for around 20 years.

» The standard also ensures that new type designs exceed the highest fuel efficiency of today's aircraft.

Will the CO_2 Standard require retrofitting to in-service aircraft?

» No. That is not practical and the CO_2 Standard does not apply to in-service aircraft.

» A certain amount of retro-fitting already takes place under the 'operations' pillar of the industry's strategy for reducing emissions. These retrofits tend to be items such as wingtip devices which can save significant amounts of fuel. However, retrofitting new engines or making substantial changes to the airframe of existing in-service aircraft is prohibitively expensive.

» Whilst it will take place over time, in-service aircraft are anyway being replaced with newer aircraft. The CO_2 Standard will ensure that these newer aircraft are more efficient.

» The new standard also specifies that changes to an aircraft design affecting emissions beyond a certain minimum level would require such aircraft to meet the standard.

Is this about overall efficiency, or just the new aircraft technology?

» The CO_2 Standard is specifically related to the technology, e.g. aircraft performance.

» The industry and ICAO have also set overall efficiency goals which relate to the full operation of the aircraft and the efficiency of the system as a whole.

Will the CO_2 Standard be subject to review?

» Yes, the CO_2 Standard will be reviewed as part of the regular cycle of ICAO's Committee on Aviation Environmental Protection (CAEP).

» With other environmental standards related to noise and local air quality, CAEP periodically undertakes technology reviews to determine whether an update to the standard is required. Our expectation is that CAEP will follow this same approach with respect to the CO_2 Standard.

» The existing standards related to noise and local air quality have been reviewed and updated multiple times, most recently in 2010 (NOx), 2013 (noise) and 2019 (particulate matter).

Why is the work being undertaken at ICAO?

» A globally interconnected sector such as aviation requires global standards in all areas.

» ICAO delivers those global standards and the CO_2 Standard follows on from past regulatory experience in areas such as safety, security and noise.

» ICAO has been creating standards for decades and, once created, stringency levels are increased and certification procedures improved to reflect technological and scientific advancements.

» For this agreement, ICAO brought together member states, global aviation stakeholders and NGOs into the negotiation process. The resulting standard is a consensus agreement.